2001 EPA Science Inventory Information

Title: Application of a 1-D Heat Budget Model to the Columbia River System

Objective/Intended Use:
The report describes a one-dimensional mathematical model of the thermal energy budget of water bodies that simulates daily or hourly average water temperatures under conditions of gradually varied flow. This model is being used by the U.S. Environmental Protection Agency to model the cross sectional average temperature of the Columbia River Mainstem. The results will be used within the Total Maximum Daily Load process to determine where temperature loading is occurring, and what kind of reductions need to be made in order to meet water quality standards.

Abstract/Summary: In accordance with Section 303 of the Clean Water Act, the states of Oregon and Washington have identified portions of the main stem of the Columbia River from the International Border (Columbia River Mile 745.0) to the mouth at Astoria, Oregon and the Snake River from Anatone, Washington (Snake River Mile 168.0) to its confluence with the Columbia River (Figure 1) as water quality limited. This designation arises from an analysis of data by the State of Washington's Department of Ecology and the State of Oregon's Department of Environmental Quality showing these waters do not meet water quality standards during all or part of the year. Under Section 303 (d) of the Clean Water Act, States are required to establish Total Maximum Daily Loads for pollutants at a level that implements the applicable standards for water temperature. The goal of Columbia River Temperature Assessment is to provide support for the priority-setting phase of the TMDL process by assessing the impacts of the principal sources of thermal energy. The central product of the temperature assessment was the development of a mathematical model that predicts temperature along the Columbia River from the Grand Coulee Dam to the Bonneville Dam and along the Snake River from its confluence with the Grande Ronde River (Snake River Mile 168) to its confluence with the Columbia.

The mathematical model predicts average daily temperatures, specific to locations along the lengths of the Rivers, but averaged across the width and depth of the Rivers.

Key elements of the model include the ability to expand the model geographically, an algorithm that quantifies the uncertainty of the modeled results, and a twenty-one year database of temperature and climate data. The model is based on the energy budget method and uses an efficient numerical solution technique that simplifies the characterization of model uncertainty. The energy budget method accounts for the exchange of heat with the atmosphere and the input of advected thermal energy from major tributaries and points sources.

The temperature assessment includes a summary of a biological study on salmon and the impacts of temperatures on their various life-stages.

Web Site Address: http://www.epa.gov/r10earth/columbiamainstemtmdl.htm

Cross-Cutting Issues: Cumulative Risk

GPRA Goal and Objective Goal 02 - Clean and safe Water

Objective 03 - Reduce Key Point Source Loadings

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